CLIMATE CHANGE COMMUNICATION AND ENVIRONMENTAL EDUCATION: FROM RESEARCH TO PRACTICE

A Thesis

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ABSTRACT

Environmental educators across the United States are delving into climate change education. The topic of climate change poses new challenges for educators intent on not only informing audiences but informing in such a way that creates lasting impact. The purpose of this qualitative study was to investigate the extent to which extent climate change communication and environmental psychology research can influence environmental education practice. Interviews with educators from five climate change related professional development programs and networks revealed a high level of awareness of climate change communication and related research. Educators accessed research through a variety of means and reported both practice change and a sense of validation as a result of the research. They also reported some tension between practice knowledge and research-based knowledge. This work begins to fill a gap both in our understanding of how informal educators communicate about climate change and in how they use research in their practice.

BIOGRAPHICAL SKETCH

Anne Armstrong was raised on the South Shore of Boston, MA. Her parents nurtured her love of nature and the outdoors from a young age, taking her to local beaches to birdwatch and encouraging her to play outside rather than watch *An American Tail* for the hundredth time. Anne's dual interests in nature and literature merged at Hamilton College, where she majored in English and minored in Geosciences. After graduating from Hamilton in 2006, Anne began what would become a career in environmental education. After two years of internships and seasonal positions, she pursued a Masters of Professional Studies in Environmental Interpretation from SUNY College of Environmental Science and Forestry. She graduated from ESF in 2010, and she and her then fiancé Greg Armstrong moved to Wallops Island, VA, where Annie started work as the Education Director for the Chincoteague Bay Field Station (CBFS), a non-profit environmental education and research field station.

At CBFS, Anne oversaw an education staff of 13. When not in the office writing schedules and coordinating the daily logistics of staffing and programs, Anne could be found out in the field—covered in marsh mud with school students, identifying shorebirds with college ornithology students, or out in the creeks with families, testing water quality and picking up trash. In 2012, Anne was awarded a Toyota TogetherGreen Fellowship that enabled her to develop a family-based citizen monitoring program with a local group called Shore People Advancing Readiness for Knowledge (SPARK). The next year, she partnered with Shippensburg University faculty and SPARK to secure a Toyota TogetherGreen Innovation grant that funded a volunteer-driven shoreline restoration project aimed at creating a model site for sea level rise adaptation and coastal resiliency practices.

These two stewardship experiences led Anne to the Civic Ecology Lab at Cornell. Anne first learned of Marianne Krasny's work in Civic Ecology at a North American Association for Environmental Education conference. She had an "aha" moment standing at the Civic Ecology booth when she realized that she had been engaging in civic ecology practices and that there were academics who could help her understand the processes and impacts of these practices. And so, two years later, Anne and her husband Greg moved back to New York State so that Anne could start a MS/PhD program in the Department of Natural Resources with Marianne Krasny. She and Greg welcomed their daughter Robin into the world in 2016.

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Introduction

As professionals who teach about the environment daily, environmental educators can benefit from using evidence-based communication and teaching strategies to reach their audiences. Krasny and colleagues (2015) argue that environmental education is particularly well-placed for handling climate change issues because it blends a scientific approach with more social or policy-oriented approaches. Indeed, informal learning centers (e.g., nature centers, zoos, aquariums, science centers) can play a crucial role in science literacy and, therefore, climate literacy, in the United States (Falk & Dierking, 2010). Environmental educators who work in these settings, however, sometimes struggle to find climate change teaching techniques that succeed in engaging without alienating learners and in communicating the science in a digestible, accessible manner. In this thesis, I investigate how nonformal and informal environmental educators who have participated in five programs—National Network for Climate Change and Interpretation (NNOCCI), Climate Urban Systems Partnership (CUSP), Project Learning Tree (PLT), Climate Literacy and Energy Awareness Network (CLEAN), and Community Climate Change Fellowship (CCCF)— translate climate change communication and environmental psychology research into environmental education practice. This work begins to fill a gap both in our understanding of how nonformal and informal educators communicate about climate change and in how they use research in their practice.

Concurrent with a dynamic and growing body of climate change communication and psychology research, environmental education professionals have increased their efforts to develop climate change education programs (J. K. Swim, Geiger, Fraser, & Pletcher, 2017). A range of environmental education programs related to climate change exists in formal, informal and nonformal settings for all ages (Hauk & Pickett, 2017). Climate change education is

inherently interdisciplinary and focuses on "understanding of the socio-political and economic considerations; the scientific basis; and the communication, collaborative problem-solving and analytical skills needed to generate and implement feasible solutions" (Downey et al., 2013). Although climate change education programs traditionally have sought to build climate literacy (Monroe, Plate, Oxarart, Bowers, & Chaves, 2017), programs have a diverse set of goals, ranging from collective efficacy (Allen & Crowley, In press) to adaptation (Krasny & DuBois, 2016).

Examining U.S. climate change attitudes illuminates the challenges climate change educators and communicators face. The majority of Americans (70%) do believe that climate change is occurring (Leiserowitz, Maibach, Roser-Renouf, Rosenthal, & Cutler, 2017). Over half of the U.S. population (58%) believes in anthropogenic climate change, while a sizeable minority (30%) believes climate change is the result of natural causes (Leiserowitz et al., 2017). With the country split among six different audience segments ranging from alarmed to dismissive (Maibach, Leiserowitz, Roser-Renouf, & Mertz, 2011; Roser-Renouf, Maibach, Leiserowitz, & Rosenthal, 2016), educators and communicators must design messages and programs that speak to wide-ranging beliefs, attitudes, and policy preferences.

While not pursued with environmental educators in mind, climate change communication and psychology research serves as a useful research corpus from which to draw ideas and strategies for education programs (Wibeck, 2014). Perhaps the largest body of climate change communication research investigates how framing strategies impact people's willingness to support climate policy and mitigation or adaptation action (e.g., Davis, 1995; Lu & Schuldt, 2015; Morton, Rabinovich, Marshall, & Bretschneider, 2011; Myers, Nisbet, Maibach, & Leiserowitz, 2012; E. C. Nisbet, Hart, Myers, & Ellithorpe, 2013; M. C. Nisbet, 2009; Scannell

& Gifford, 2013; Spence & Pidgeon, 2010; Spence et al., 2012). Researchers from across the social sciences have also explored the reasons for polarized climate change attitudes (Brownlee, Powell, & Hallo, 2013; Dickinson, 2009; Kahan, 2012; Markowitz & Shariff, 2012; Pearson & Schuldt, 2015; Spence et al., 2012) and the impacts of mass media (Hart & Feldman, 2014) and of culture and identity on climate change attitudes and behaviors (Bliuc et al., 2015). While this research is now being applied to educational settings (Busch, 2016), the majority of empirical research on climate change education has been conducted in formal settings (Monroe et al., 2017).

With these trends in mind, I asked the following research questions:

1) To what extent are nonformal educators aware of climate change communication and environmental psychology research and how do they find out about the research?
2) To what extent are environmental educators applying climate change communication research in their practice?
3) Which frames do educators use or report using to discuss climate change?

Research questions 1 and 2 address a gap in the environmental education literature regarding the role of research in practice, while research question 3 addresses a gap in climate change education and communication literature by focusing on the framing tendencies of nonformal and informal educators.

Literature Review

Introduction

Environmental education researchers call for climate change education to be guided by the research domains that inform climate change communication, such as communication theory and psychology (Brownlee et al., 2013; P. R. Davis & Russ, 2015; Kunkle & Monroe, 2016; Wibeck, 2014). Climate change communication (CCC) is:

> "…about educating, informing, warning, persuading, mobilizing and solving this critical problem. At a deeper level, climate change communication is shaped by our different experiences, mental and cultural models, and underlying values and worldviews." (Yale Program on Climate Change Communication, n.d.)

Wibeck (2014) argues that "the history and future of CCC could influence the design of environmental education, primarily in non-formal settings where lay people become learners outside the formal school context" (p. 388). Davis and Russ (2015) see framing as a research area and a communication strategy that unites science communication and science education efforts, and they argue for greater conversation between the two fields. Education-related studies apply climate change communication framing techniques in formal, informal, and nonformal education settings and in educator trainings with the goal of enhancing climate literacy and promoting action (e.g., Busch, 2016; Dickinson, Crain, Yalowitz, & Cherry, 2013; Otieno et al., 2014; Stevenson, King, Selm, Peterson, & Monroe, 2017). Swim and colleagues have reported extensively on the impacts of the National Network for Ocean and Climate Change Interpretation (NNOCCI) training program, which includes instruction in social movement framing using values frames and extended metaphors (Geiger, Swim, Fraser, & Flinner, 2017; Swim & Fraser, 2014; Swim & Fraser, 2013; Swim et al., 2017).

Little research to date explores how environmental educators access and use research. The North American Association of Environmental Education (NAAEE), however, is working with researchers from Duke University's Nicholas School to develop an online database of environmental education research syntheses with the goal of transforming that research into environmental education practice (Roth, 2017). The process of research translation goes by several different titles, such as "knowledge mobilization" (Rodway, 2015), "diffusion of innovation" (Dingfelder & Mandell, 2011), and "knowledge transfer and exchange" (Mitton et al., 2007). Studies examining the flow of research to practitioners span multiple fields, including health (Mitton, Adair, Mckenzie, Patten, & Perry, 2007), education (Schneider, 2015) and conservation (Knight et al., 2008). Fields such as health and education have embraced the concept of evidence-based practice, although some in the education field remain skeptical of this model's benefits because it restricts the scope of evaluating education to questions of effectiveness (Biesta, 2007).

Schneider (2015) presents four key factors that influence whether educators adopt research-based practices: visibility (research is accessible and its quality can be determined); acceptability (research understood as valuable, conforms with educator worldview); feasibility (applying research does not require an overhaul of practice); and transportability (research is easily shared across networks and with audience). What does it mean to adopt a research-based practice? How educators apply research varies. Educators may use research instrumentally by changing their practice as a result of the research, conceptually to shape how they think about problems and solutions, or tactically to change policy or make organizational level changes (Davies, Nutley, & Walter, 2008; Finnigan, Daly, & Che, 2013). Intermediaries such as colleagues, the media, and professional development opportunities like those described in this

thesis play an important role as knowledge brokers (Meyer, 2010) in disseminating research to education practitioners (Cooper & Shewchuk, 2015)

Climate change communication and related research might be applied instrumentally in two areas of educator practice: program language, or framing, and audience assessment. Figure 1 illustrates the interconnections between fields of research, environmental education trainings, and environmental education practice. Studies on identity, psychological distance, and affect and emotion inform framing research. Knowledge brokers such as professional development training organizations and networks, gray literature, news media, and social media translate this research. Some educators may access research via knowledge brokers, while others may access research directly through peer-reviewed journal articles or gray literature. Framing research may inform directly the language educators choose to use in their programs, and research on identity, psychological distance, and affect and emotion can serve as tools in "knowing your audiences," a keystone of best practice in environmental education. The interplay between these research streams and their potential application in practice serves as a guiding framework for this thesis.

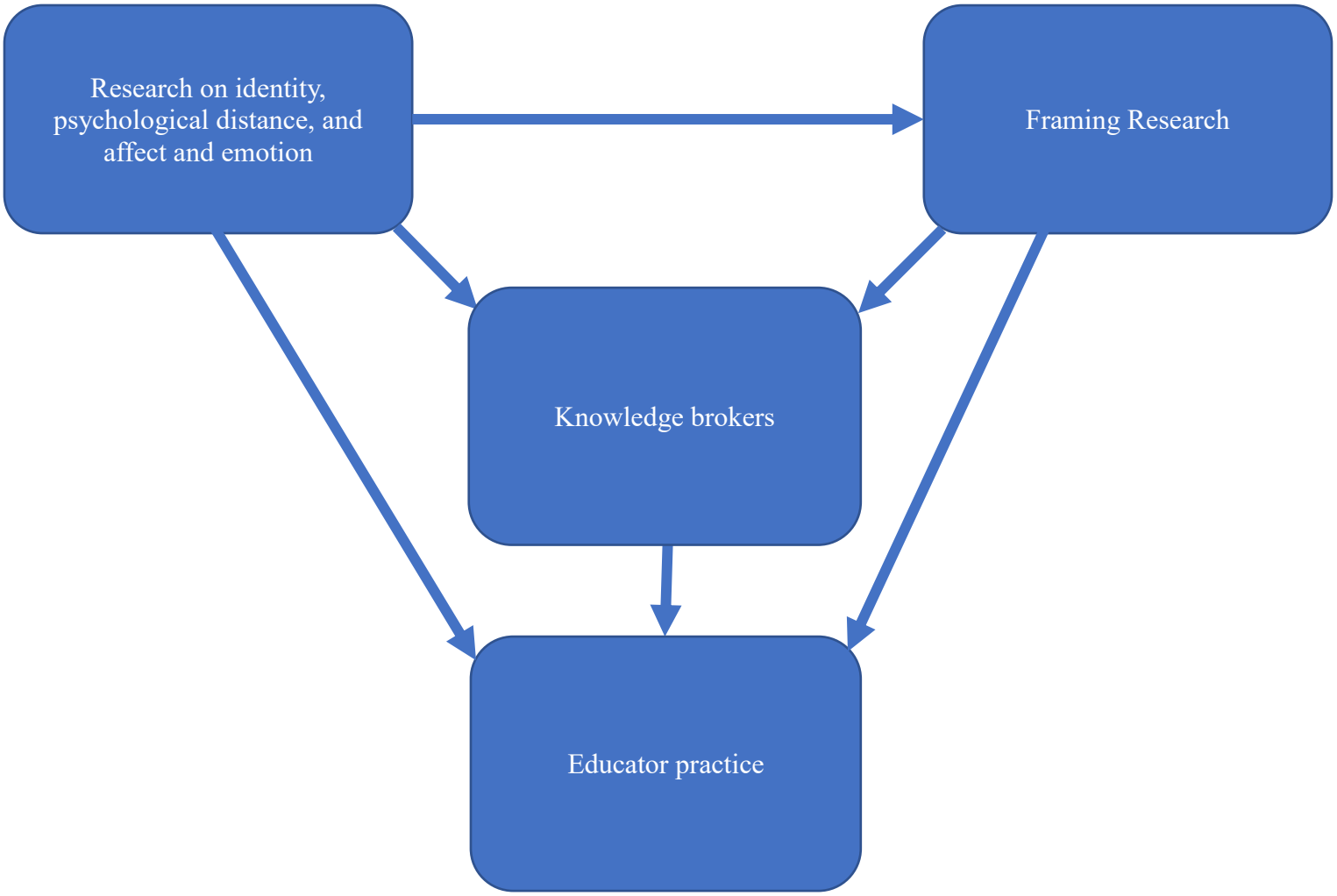

Figure 1

Conceptual framework linking research and practice

Framing

Framing literature sprawls across social sciences disciplines and has been termed a "fractured paradigm" (Entman, 1993). Climate change communication researchers investigate the role of framing in climate change attitudes and behavior (e.g., support for climate policy). Researchers have conducted experiments on equivalency frames that present the same information in opposite terms—for example, 97% of climate scientists agree vs. 3% of climate

scientists disagree—and on emphasis frames that appeal to select knowledge (Druckman, 2001; Schuldt & Roh, 2014). These frames make different ideas salient, which in turn can affect judgment. The FrameWorks Institute, whose research underpins the NNOCCI program, roots its framing philosophy in part in social movement theory (FrameWorks Institute, 2005). Social movement theory describes frames as tasks that organize messages; diagnostic frames identify a problem, prognostic frames identify why the problem exists, and motivational frames suggest solutions to the problem (Benford & Snow, 2010). These tasks provide a meta-structure for messages, while emphasis and equivalency frames drive the argument. Entman neatly synthesizes these different theoretical approaches and writes that "to frame is to *select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described*" (Entman, 1993, p.52, emphasis in original). This literature review focuses heavily on research related to emphasis and equivalency frames due to their prominence in climate change communication literature.

Framing research overlaps with climate change research in the domains of psychological distance, emotion, and identity (Table 1), although each domain is interwoven through different means. While psychological distance allows framing researchers to test a set of frame types (e.g., local or global, socially proximal or socially distant) on climate change behavior or attitudes, affect and emotion serve as desired framing effects (e.g., study participants feel more hopeful after reading a news article framed around health). Identity research provides a mechanism through which to analyze framing effects as well as a lens through which to frame (see Krantz & Monroe, 2016). Framing, then, is a mechanism through which these three concepts can be applied in practice.

Table 1

Examples of studies connecting framing with other dominant trends in climate change literature

Research Category	**Example Framing Studies**
Psychological distance	Hart, Stedman, & McComas, 2015; Pidgeon & Spence, 2010; Dickinson et al., 2013a; Rickard et al., 2016
Identity	Myers et al., 2012; Schuldt & Roh, 2014; Severson & Coleman, 2015)
Emotion and affect	Hart et al., 2015; Lu & Schuldt, 2015; Myers et al., 2012

While framing researchers have experimented with a wide variety of frame types, valence frames (positive vs. negative or gains vs. loss) emerge as a trend in climate change studies. Valence frames depict climate change in a positive or negative light (Busch, 2016) or, for example, in terms of what can be gained from acting to mitigate climate change versus what might be lost by not acting (Morton et al., 2011; Spence & Pidgeon, 2010). Framing research highlights the news media's use of negative, doom and gloom framing (Hart & Feldman, 2014); framing experiments, however, suggest that positive frames or those frames that highlight what might be gained from action result in more positive attitudes towards climate change action compared to negative frames (Morton et al., 2011; Spence & Pidgeon, 2010). Work with citizen scientists suggests positive frames that highlight collective efficacy can foster climate change engagement (Dickinson et al., 2013), while work from the museum world demonstrated audiences' desire to end climate change narratives with a positive message about action (Koepfler, Heimlich, & Yocco, 2010).

Research on framing in education settings explores the impact of different frames on student populations, although there are limited studies on the frames employed by educators in these settings. In a case study with North Carolina adolescents from agricultural backgrounds, environment and agriculture frames elicited significantly more hopefulness than did health frames even among students who were skeptical of anthropogenic climate change (Stevenson et al., 2017). Students in a German study had a narrower understanding of climate change when it was presented using sensational, doom and gloom frames (Otieno et al., 2014). As might be expected, science teachers privilege science frames, yet researchers note that a social discourse may be more effective at promoting action (Busch, 2016). Research on framing in environmental or science education underlines the fine balance educators must strike between communicating risk while eliciting hope and self-efficacy.

Framing research is limited in its generalizability to real-world situations because most research examines frames in isolated conditions (Bernauer & McGrath, 2016; Borah, 2011; E. C. Nisbet et al., 2013). The literature also lacks depth in frame production studies that examine processes by which organizations and individuals develop frames (Borah, 2011). The present study differs from most communication research that addresses framing, in that it does not test frames for their effects but explores the use of frames in current environmental education practice.

Psychological distance

Emphasizing climate change as a distal or proximate phenomenon represents a choice educators make when framing climate change. The concept of psychological distance explains the conceptual difficulties the public has with climate change and climate change action (Weber, 2016). Construal level theory posits that people think more concretely about proximal events and

more abstractly about distant events, and that psychological distance has four key elements: temporal distance, spatial distance, social distance, and uncertainty (Liberman, Trope, & Wakslak, 2007; Spence et al., 2012). Studies investigating barriers to climate change action describe how people view climate change as psychologically distant in each of these dimensions (Leiserowitz, 2005; Lu & Schuldt, 2015; Spence et al., 2012).

Several studies have examined the role of spatial and temporal proximity. In a survey of residents from British Columbia, Scannell & Gifford (2013) tested local and global frames and their relationship with place attachment and climate change engagement. They found that people who had higher levels of place attachment (i.e., to local, close environments) were more engaged with climate change information. Their findings promote the practice of tying climate change communication or education to local areas rather than to distant places and have been cited in science education literature for practitioners (Busch & Osborne, 2014). UK survey respondents, however, viewed climate change as a higher risk for faraway regions and future time periods (Spence & Pidgeon, 2010), suggesting that framing impacts as distant may also prove useful in promoting climate change engagement, depending on the audience.

In addition to spatial and temporal issues, psychological distance relates to the distance that someone might feel toward another person or toward society. Markowitz & Shariff (2012) and Jamieson (2016) propose that climate change fails to activate our sense of moral judgment because it is an abstract concept about which individuals feel only indirectly responsible. Lu and Schuldt (2016), however, demonstrated that, among conservatives and moderates, using compassion appeals aimed to reduce social distance could increase people's compassion for others suffering climate change impacts and, in turn, increase policy support for climate change

action. Along with restructuring the way we think about ethical issues, Jamieson (2016) suggests making the distal proximate: bringing climate change closer to home as a moral and ethical issue.

The notion that psychological proximity may affect climate change engagement is reflected in principles and methods from the closely linked fields of environmental education and interpretation. Place-based education, for example, is the "process of using the local community environment as a starting point" for instruction with the goal of enhancing academic achievement and developing strong community ties, an appreciation of the natural world, as well as a "heightened commitment to serving as active, contributing citizens" (Sobel, 2004, p. 7). A guiding principle of the field of interpretation is that "any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile" (Tilden, 2008, p. 15). One way of ensuring that an interpreter's program relates to "the personality or experience of the visitor" is to underline how climate change impacts local people and places and how visitors may have even experienced some of these impacts already in their lifetimes.

Some researchers propose, however, that because people consider climate change to be a greater risk when it is framed as a distant issue rather than a local issue, focusing on global implications may garner support for pro-environmental behavior (Spence & Pidgeon, 2010). These findings reflect a tension uncovered elsewhere in psychological distance literature. Rickard, Yang, & Schuldt (2016) found that U.S. conservatives were more likely to support climate mitigation policy when they read a message framed as spatially close and temporally distant, which contradicts the notion that framing climate change as proximal in all dimensions (spatial, temporal, and social) will result in higher levels of policy support or climate change engagement. Similarly, Levine & Kline (2017) demonstrated in field and survey experiments

with two environmental organizations that texts on climate change risks framed around public health and food (proximal frames) increased support for policies but decreased willingness to take political action. Brügger and colleagues (2015) explored different perspectives on proximizing climate change and concluded that, "At best, proximizing will be successful in encouraging people to take steps to mitigate or adapt to climate change. At worst, this strategy will lead to defensive reactions such as increased skepticism about the reality and relevance of climate change" (p. 1035). Complex and sometimes convoluted findings such as those from the psychological distance literature present a challenge in translating research to practice; researchers tend to simplify their findings and suggest practitioners frame climate change around the local rather than the global (Brügger et al., 2015; EcoAmerica & CRED, 2014; Scannell & Gifford, 2013).

Identity

Exploring the role that identity plays in engagement with climate change information can inform frame choices and begins to address the issue of why there are "six Americas" (six distinct audience segments) (Maibach, Leiserowitz, Roser-Renouf, & Mertz, 2011) in the United States with different climate change beliefs and policy preferences. Not only does identity serve as a theoretical lens through which to view framing effects, identity research can directly inform educators' evaluation of their audiences while planning programs. Authors have written about climate change and identity using a variety of standpoints, from motivated reasoning (Hart & Nisbet, 2012) to identity protective cognition (McCright & Dunlap, 2011) and cultural cognition (Kahan, 2012, 2013, 2015; Kahan et al., 2012). Motivated reasoning is a thought process that leads people to use beliefs and strategies to arrive at a desired conclusion, one that tends to protect a sense of self or identity (Kunda, 1990). Kahan and colleagues (2007) conceive of

identity-protective cognition as a part of cultural cognition, i.e., a motivated reasoning process by which individuals conform their beliefs to their social identity in-group, rather than their cultural in-group as defined by Douglas and Wildavsky's (1983) cultural theory of risk (i.e., egalitarian-communitarian or hierarchical individualist). While the concept of cultural cognition has come under fire recently based on the premise that it is neither a theory about cognition nor about culture (van der Linden, 2016), what remains clear is that identity plays a crucial role in defining people's engagement with climate change information.

Much climate change and identity research focuses on political affiliation as a driving, polarizing factor that interacts with people's interpretation of climate change information (Hart & Nisbet, 2012; Hoffman, 2015; Kahan, 2015). When faced with the same information about climate change, Republicans and Democrats polarize on their willingness to support climate policy (Hart & Nisbet, 2012). Kahan found that scientific numeracy correlated negatively with a conservative's likelihood of believing in anthropogenic climate change and positively with a liberal's likelihood of believing in anthropogenic climate change (Kahan et al., 2012). Information and the capacity to understand scientific information lose out to political identity in deciding what to believe about climate change.

Although a recent meta-analysis of climate change belief-correlates identifies political party as the strongest predictor of climate change belief (Hornsey, Harris, Bain, & Fielding, 2016), researchers have explored other ways of looking at climate change and identity. The need to conform to one's social identity group may play a larger role in determining climate change attitudes than political leanings alone, and Bliuc and colleagues (2015) suggest that self-identified "skeptics" and "believers" constitute their own psychological groups formed around contrasting views of the issue of climate change. Believers and skeptics are identities that

transcend political outlook. Additionally, among racial and ethnic minorities in the United States, climate change attitudes are less dependent on political identity than they are among Whites, suggesting that educational programs aimed to reduce polarization may not be necessary or impactful among people of color (Schuldt & Pearson, 2016).

Past research on identity and environmental education primarily centered around environmental identity (Green, Kalvaitis, & Worster, 2015; Payne, 2001; Williams & Chawla, 2015); however, a new body of research exploring primarily social identity and climate change is growing. One study with North Carolina middle school students found that, as with adults, hierarchical-individualist worldviews were correlated with lower rates of acceptance of climate change (Stevenson, Peterson, Bondell, Moore, & Carrier, 2014). However, this study also revealed that students' belief in climate change increased after receiving climate change information regardless of worldview, which contrasts with adults, who are more entrenched in their worldviews. Survey research revealed that science teachers' political ideology determined their approach to climate change in the classroom; teachers who were more conservative were more likely to teach "both sides" of the climate issue rather than to focus on consensus (Plutzer et al., 2016). Stevenson and colleagues (2015) found that wildlife science students evaluate risk to wildlife differently than they evaluate risk to humans. While they rely on affect-related mental shortcuts, determined in part by political affiliation, to assess climate change risk to human society, they rely on their *knowledge* of climate change to assess risk to wildlife. Identity, therefore, does not necessarily drive some audiences' perception of climate change risk for non-human life.

Values

Values help define social identities, serve as guiding principles in our lives, and have been linked to pro-environmental behavior (Graham, Haidt, & Nosek, 2009; Schwartz, 1994; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Three value types are particularly relevant when explaining environmental behavior: altruistic values (focus on the welfare of other people), biospheric values (focus on the welfare of the environment) and egoistic values (focus on oneself). Some research identifies altruistic values (i.e., those related to social justice or ensuring the health of others) as stronger motivators of low-carbon behavior (Howell, 2013; Howell & Allen, 2017) and of climate policy support (Simon, Volmert, Bunten, & Kendall-Taylor, 2014) than biospheric values. Recent work with forest landowners in the Southeastern United States, however, demonstrated that stewardship (biospheric) frames increased landowner feelings of efficacy (Krantz & Monroe, 2016). This finding suggests that forest landowners hold environmental values despite their conservatism and that communicators may be able to harness these values to promote climate change engagement. While much of the literature (gray literature included) on values promotes values-based frames, framing experiments with values are lacking.

Emotion and Affect

Educators may choose frames that elicit certain emotions, such as hope. Recent survey research shows that concern about climate change is at an all-time high (Gallup, 2016) and that over half of Americans are worried about global warming (Leiserowitz et al., 2017). Affect, which is "the faint whisper of emotion" (Slovic & Peters, 2006), as well as emotions like concern and hope play multiple roles in the processes of climate change communication and education, and can inform framing choices. Affect and emotion can determine how people judge climate change as a risk (van der Linden, 2017), whether they support policy (Hart, Stedman, & McComas, 2015), or whether they decide to take climate change action (Ojala, 2012). Risk

perception research demonstrates that people frequently evaluate risks based on their feelings rather than on the pros and cons of a situation (Leiserowitz, 2006; Slovic, Finucane, Peters, & MacGregor, 2004) and emotions may elicit support for climate change policy differentially among political groups (Lu & Schuldt, 2015).

Yet the relationship among fear, concern, and action is complex. One might infer that, because negative affect increases concern (Leiserowitz, 2006), messages that produce negative affect might increase the likelihood of climate change action. Fear appeals dominate media coverage of climate change (O'Neill & Nicholson-Cole, 2009); however, fear has been related to climate change inaction, or, even worse, actions that intensify climate change (Dickinson, 2009; P. S. Hart, 2013). To complicate matters, fear may enhance information retention in students while at the same time leading to narrower and less thorough information-processing, which could, in turn, affect climate change understanding (Otieno et al., 2014). O'Neill & Nicholson-Cole (2009) found that the fear-inducing images that made people most concerned about climate change also made them feel powerless on a personal level to act; conversely, those images that elicited hope failed to make people think of the issue as very important. U.S. newspapers that present threat messages without corresponding solution messages to bolster efficacy may invoke fear responses and diminish the likelihood of climate change engagement (Feldman, Hart, & Milosevic, 2017; P. S. Hart & Feldman, 2014).

Environmental education and climate change communication researchers have also investigated the role hope plays in policy support and climate change action. Hope is an emotion associated goal-setting, pathway thinking (how to reach goals), and agency thinking (a motivation to use pathways) (Snyder et al., 1991) and has been shown to motivate action. Myers and colleagues (2012) investigated the effects of different frames on emotions related to climate

change and found that conservatives felt hopeful after reading messages about climate change framed through the lens of public health. Environmental education researchers have also recently begun to explore the role of hope in climate change action and attitudes. Work with adolescents links feelings of hope with willingness to engage in energy conservation actions (Ojala, 2012, 2015) and pro-environmental behavior (Stevenson & Peterson, 2016). Swim & Fraser (2013) write of the "emotional labor" and associated burn-out related to teaching about emotionally charged issues like climate change in their evaluation of NNOCCI, concluding that the training made educators more hopeful and more energized to teach about climate change by enhancing their climate change interpretation skills and connecting them to a network of concerned peers.

Metaphor and Analogy as Tools in Framing

Metaphors are sometimes used in framing climate change (van der Linden, Leiserowitz, Feinberg, & Maibach, 2015). A metaphor is a figure of speech that makes an implicit, implied, or hidden comparison between two things that are unrelated but share some common characteristics (Chen, 2012). Russill (2011) notes that "metaphor is ubiquitous in climate discourse. There are hothouses and greenhouses, atmospheric blankets and holes, sinks and drains, flipping and flickering switches, conveyor belts and bathtub effects, tipping points and time bombs, ornery and angry beasts, rolled dice, sleeping drunks, and even bungee jumpers attached to speeding rollercoasters" (p. 115). Recent work suggests metaphors are effective in communicating certain climate change issues like scientific consensus (van der Linden et al., 2015). Flusberg, Matlock, & Thibodeau (2017) found that war metaphors gave their study respondents a greater sense of urgency about climate change. Other research suggests fear appeals are not only hard to maintain, but may be counterproductive to action (O'Neill & Nicholson-Cole, 2009).

Researchers have also considered the role of metaphors in environmental education. Bowers (2001) wrote about the "double-bind" of the metaphors embedded in educators' language and thinking, which can perpetuate misunderstanding or fail to move a concept forward if the metaphors remain rooted in the capitalistic, consumer-driven meta-schemata they seek to deconstruct. FrameWorks Institute used street interviews and an experiment embedded in a survey to test a series of metaphors related to climate change and the ocean and found that "climate's heart," "rampant vs. regular carbon dioxide," and "osteoporosis of the sea" were the most effective at increasing understanding of climate change and that these remained in people's minds after exposure (Volmert, 2014). As a result of this study, NNOCCI adopted these metaphors in their training programs alongside the earlier developed metaphor of a "heat-trapping blanket," which describes the role of greenhouse gases in the atmosphere (Bales, Sweetland, & Volmert, 2015).

Methods

To gain insight into the extent to which educators were aware of and applying climate change communication and environmental psychology research in their programs, I conducted semi-structured interviews with environmental education professionals. I selected professionals involved in climate change education training programs and networks.

Data Collection

Sample

I used a mix of stratified purposeful (Patton, 1990) and snowball sampling (Mertens, 2005) to identify for interviews 19 environmental education professionals working with climate change education programs on a regional or national level (Tables 2-4). Interviewees occupied a variety of organizational roles and worked with a wide range of audiences, from young children to town planners. Many interviewees worked with multiple audiences in their professional roles (e.g., a zoo education coordinator might train volunteers and interact with the public). To keep terminology simple in my findings section, I will refer to all interviewees as "educators" and not use their official titles.

I first identified Project Learning Tree's (PLT) Southeastern region climate change education curriculum, *Southeastern Forests and Climate Change* (Monroe & Oxarart, 2014). The print module includes references to communication research, and the online companion site includes links to climate change communication research and reports. To begin assessing whom to interview, I contacted the module authors and had an informal phone conversation. I received recommendations for PLT state coordinators to interview, whom I contacted via e-mail. I identified 3 additional state coordinators via a web search on the PLT national and Southeastern state websites, during which I looked for evidence of states having offered professional

development workshops on the module. To gain additional perspective I interviewed one facilitator who had participated in a professional development training based on the module and had in turn co-facilitated a training for other educators in her state. PLT educators with whom I spoke worked mostly with formal classroom teachers and forestry professionals and students, and occasionally with non-formal educators (Table 2).

I next identified two programs funded through the National Science Foundation's Climate Change Education Program (CCEP): National Network for Ocean and Climate Change Interpretation (NNOCCI) and Climate Urban Systems Partnership (CUSP). NNOCCI is a national training program whose goal is to "establish a national network of professionals who are skilled in communicating climate science to the American public in ways that are engaging and stimulate productive dialog" ("NNOCCI," n.d.). I contacted the program principle investigators and received recommendations for 6 NNOCCI alumni and 1 CUSP educator (Table 3). I interviewed a seventh NNOCCI alum identified by a CCCF educator. The NNOCCI alumni were from states nationwide; the majority were employed as education coordinators or directors at zoos and aquariums, although two were employed at state-level conservation NGO's.

CUSP is a network of informal educators, learning scientists, climate scientists, and community organizations that operates in Philadelphia, Pittsburgh, New York City, and Washington, D.C. CUSP creates informal learning experiences centered around local climate change impacts and solutions. I first contacted CUSP learning scientists, who recommended a museum educator involved in designing learning experiences for the program.

I identified Climate Literacy and Energy Action Network (CLEAN), a national climate change education list-serve and climate change resource clearinghouse, and contacted 2 members who themselves run statewide or regional education programs and participate regularly in the

list-serve discussions. Using a snowball method, I identified one additional educator from CLEAN (Table 4).

Finally, I identified the EE Capacity Community Climate Change Fellows (CCCF) Program, a national climate change education training program, facilitated by the North American Association of Environmental Education (NAAEE) and Cornell University. I contacted the program coordinator, who put me in touch with 2 CCCF educators (Table 5).

Taken as a group, the programs I identified had made a commitment to climate change education and reached audiences from cradle to gray in 15 states, in nonformal and informal settings, and in rural, suburban, and urban areas. Sixteen of the interviewees were female and 3 were male. 18 interviewees were White, while one was Latina. Using these programs, I attempted to maximize difference in organization type to develop a sense of how climate change communication strategies are applied across EE while ensuring that interviewees were educators who had reflected on climate change education strategies prior to the study.

Table 2

Professional title and organization type of PLT educators

Professional Title	**Interviewee Organization Type**
1. State Coordinator	Private non-profit state forestry association
2. State Coordinator	Private non-profit education organization, heavily funded by the state
3. State Coordinator	State environmental education professional organization
4. Children's Programmer	County library system
5. State Coordinator	State cooperative extension
6. State Coordinator	State Department of Forestry

Table 3

Professional title and organization type of NNOCCI and CUSP educators

	Professional Title	Organization Type	Program
1.	Education Specialist	Non-profit environmental organization	NNOCCI
2.	School Program Specialist	Aquarium	NNOCCI
3.	Training Program Coordinator	National Estuarine Research Reserve	NNOCCI
4.	Director of Education	State-wide conservation non-profit	NNOCCI
5.	Docent and Interpretation Coordinator	Zoo	NNOCCI
6.	Education Manager	Aquarium	NNOCCI
7.	Outreach Coordinator	Zoo	NNOCCI
8.	Program Development Coordinator (CUSP)	Museum	CUSP

Table 4

Professional title and organization type of CLEAN educators

	Organization Role	Organization Type
1.	Climate Change Education Manager	Non-profit natural history museum
2.	Education Director	Non-profit climate change education and advocacy organization
3.	Director of Teacher Programming	Non-profit natural history museum

Table 5

Professional title and organization type of CCCF educators

Organization Role	Organization Type
1. Education Director	Non-profit conservation organization
2. Founder	Non-profit climate change education organization

Interviews

I developed a semi-structured interview guide (Appendix A) that included questions that established the context in which educators were teaching about climate change, how educators were teaching about climate change (e.g., what type of language, teaching strategies, and information sources they use), and whether they were actively aware of communication research. I conducted a preliminary interview with a climate change educator from a coastal non-profit addressing sea level rise to test the interview guide and adapted the guide to better address research questions and facilitate interviewees' comfort.

I conducted interviews using Skype and recorded interviews using the software Evaer. Interviews lasted 25-60 minutes. I took notes during interviews of key moments and afterward wrote a short reflection on the interview to spur analysis and jog my memory in the future.

I transcribed and began initial coding (Charmaz & Belgrave, 2002; Saldaña, 2013) of interviews shortly after each interview. This process enabled reflexivity as I progressed through interviews (Charmaz & Belgrave, 2002), adjusting interview probes and questions as needed to address aspects of my research that had not emerged through previous interviews. Eighteen out of 19 interviews were transcribed verbatim, while for the 19th I relied on my interview notes due to an Evaer software malfunction during the interview.

Data Analysis

I started my analysis with a careful and close reading of interview transcripts, using Word comments to enter initial codes and reflections to gain a sense of the relevant concepts that emerged from the interview text (Charmaz & Belgrave, 2002; Corbin & Strauss, 2008). These codes and categories were a blend of a priori codes defined by the literature review and trends that emerged from the interviews. This close reading combined with the verbatim transcriptions gave me "rich data" and enhanced the descriptive validity of the research (Maxwell, 1996).

I then developed a set of 21 structural categories (Saldaña, 2013) and, using a spreadsheet, grouped initial codes under these categories. Categories were mostly drawn from the a priori concepts that guided the structure of the interview itself, although I also used the language of interviewees to define more emergent codes. I began a second phase of coding (Saldaña, 2013) using NVivo, entering the categories and codes from the spreadsheet into the software and recoding the interviews, and writing memos to remind myself of key points. I then used the software's query tool to identify pertinent groupings of categories, codes, and quotations that I employed to develop the themes presented in the findings. I continued analysis through the process of writing memos and drafts (Wolcott, 2009).

To enhance the validity of the study and gain a better understanding of the programs the educators conducted, I requested lesson plan materials from NNOCCI educators. Nine educators sent copies of climate change education materials, including lesson plans, presentations, activity props, and workshop agendas. I also familiarized myself with the introduction to the PLT module and the activity most frequently cited by interviewees, read online about the recent community outreach campaign a CLEAN educator's organization embarked on, and visited the climate change exhibit designed by another CLEAN educator. This exercise enabled me to have a

"prolonged engagement" with the interviewees' programs and to better understand the contexts within which they were operating (Lincoln & Guba, 1985).

Findings

Awareness and Points of Access

Sixteen of 19 educators had heard about or reported reading climate change communication or education research. Educators described multiple points of access to research (Table 6). Training, news and social media, colleagues, and popular nonfiction served as pathways or filters through which research-based practice was disseminated. Other points of access to research included reading non-peer reviewed research reports from private research groups like FrameWorks Institute and EcoAmerica.

Practice Change

According to the literature, identity and psychological distance can inform framing choices, which would then be reflected in educator practice instrumentally in the language educators use to describe climate change and conceptually in how they conceive of their audiences. In this section, I portray how NNOCCI, CUSP, CLEAN, and CCCF educators described practice change as a result of research in terms of framing individual ideas and whole programs. I also describe how PLT educators used the research foundations of the climate change module to build trust with their audiences.

Table 6

How educators learned about research

Point of Access	**Example**
Professional development	NNOCCI is the only thing I've found that gives very concrete recommendations that have been researched and tested (NNOCCI educator). We were briefed on it from the Pine Map people, but I didn't do any [reading] of my own (PLT educator).
Colleagues	Her master's thesis was on [state residents'] knowledge, attitudes, and behaviors on climate change, so she had some really interesting findings about what drives people's beliefs in climate change, and it's very much the popular media not the, not what they actually know to be a fact (PLT).
Popular nonfiction	I was reading, George Marshall--*Don't Even Think About It*. His new book about climate change (CCCF educator).
Research report (gray literature)	EcoAmerica I think it is put out that guide to talking about climate change and they have the 13 key steps so we use the ones that we agree with (CUSP educator).
Research presentation	We all attended Suzanne Moser's workshop in the fall (CCCF educator).[1]
Social media	There's probably about a dozen of us who are regularly sharing reports and articles and resources for understanding what's going on in the world, and that's incredibly powerful I think (CLEAN educator).

[1] Moser has edited volumes and published peer reviewed articles on climate change communication. She is a Social Science Research fellow at Stanford's Woods Institute for the Environment, a Research Associate at University of California Santa Cruz, and Director and Principle Researcher of Susanne Moser Research and Consulting.

NNOCCI educators described their practice in terms of the FrameWorks Institute's research and how it changed their program language. One participant explained how she developed an activity for high school students that uses all four of the "research-tested metaphors." Two other participants explained how their program language had changed:

> I guess I was just talking about [climate change]. I wasn't doing the heat-trapping blanket, I also wasn't necessarily using connecting with people using a value at the very beginning of the conversation…. And what the research shows is you really want to connect with people right away early and often, actually with a value that resonates with most people. The research shows those values are protection and responsible management (NNOCCI educator).

> (E)ver since I did the NNOCCI training, I was able to revamp that presentation and make sure I framed it in a way that was consistent with the NNOCCI recommendations and using the different elements like explanatory metaphors and things like that (NNOCCI educator).

The CUSP educator referenced a literature review that informed the project's logic model, describing how the review confirmed other research that proposes:

> (C)limate science itself has not led to any increased concern or change in attitudes or behaviors on climate change. That allowed us to reject the idea that we needed to teach climate science itself with this project (CUSP educator).

CLEAN and CCCF educators stressed how accessing research led them to approach their programs from the perspective of audience identity and values rather than from a strict focus on presenting climate science and facts. A CCCF educator emphasized that "It's really…the values that people have, and it's appealing to those things and having conversations about those things and not being dogmatic about trying to win an argument." A CLEAN educator described how "It's about understanding their worldview, their tribe." The CCCF educator who worked for a bird-focused non-profit described how "the research seems to be pretty consistent. There's the values and there's the social pressure," but that she was frustrated that that message "has been really slow to be heard and implemented in terms of an approach." She planned to develop a

training that focused on communication skills for her organization and partner organizations that helped staff integrate climate change into their programs:

> I don't think we need to give our staff facts. We are going to do a bare bones climate change 101 in the beginning just to make sure we're all in the same place with information. But then it's going to be about communication skills, both listening and verbalizing (CCCF educator).

The other CCCF educator, who left a career in academia to work with adult environmentalists on climate action, discussed her work in translating research:

> I've gone deep, deep, deep into cultural cognition with Dan Kahan because this is really important, and Kahan himself is disseminating it at one level, but it is not reaching the level that I'm working at all. I'm talking to folks who it would never cross their minds, and it needs to cross their minds. So, I took it upon myself to translate his stuff to try to create workable public education tools out of it (CCCF educator).

PLT educators spoke about the forestry and scientific research included in the module in the context of their audiences trusting in research. One educator discussed trust in forestry research in the context of her audiences when she mentioned the "Changing Forest" activity in the PLT module:

> [The module is] based a lot on you know current research that's going on in the field. So again, it's difficult especially with our foresters and professionals and our forestry students it's difficult for them to discredit the research that the U.S. Forest Service is doing (PLT educator).

Another PLT educator recognized that his audience does not have implicit trust in research even as he emphasizes a fact and citation-based approach:

> So, we really lay out the facts. And then still, you know the facts are questionable as well, but we try to, we just more or less lay out the facts and provide the citations that show where those numbers and facts came from (PLT).

Practice Validation

In addition to describing how their practice had changed because of research, educators discussed feeling like their practice had been validated by research. A NNOCCI educator

described how research by the Climate Literacy Zoo Education Network helped her because it "validates what I do. I'm not like, why are you spending all of this time doing something that doesn't matter?" Another NNOCCI educator framed the confidence she gained from NNOCCI in part around its research foundations:

> I think now that we have these techniques and we were able to say these were research tested, we know that these will work, this isn't just us thinking they will work, they've been proven to work. That was really kind of the ticket (NNOCCI educator).

A PLT educator described the impact of learning about environmental psychology research through a professional development course:

> There were a couple things related to environmental psychology which really struck me…It was just the whole way of looking at it was very interesting to me. It was, it had a logic to it that I felt like verified my point of view of a lot of things and also that I felt like would make it easier for me to communicate to other people the concepts I was trying to share (PLT educator).

Research-based Knowledge vs. Practice Knowledge

Even as some educators felt validated by research, they also evinced a tension between trusting the research their programs were based in and drawing on their personal experience to complement, and in some cases, go against this research. On the one hand, NNOCCI educators described the sanctity of the metaphors developed for NNOCCI by FrameWorks Institute, explaining why they do not create their own metaphors for programs:

> No, because it's actually recommended that you don't create your own metaphors because a lot of research and testing went into the ones that were developed by FrameWorks Institute our partner in the NNOCCI project, so that's why they're so powerful because they've been researched and tested (NNOCCI educator).

In contrast, another educator described how, not only does she not like the “osteoporosis of the sea” metaphor, but how other educators have developed their own metaphors or analogies as a response:

> I'm not a big fan of the osteoporosis of the sea. Most of us are not super thrilled with it, but it works. But there's other things that people have used, making connections to lemonade, and things like that and the ocean being like a sponge, that have worked as well. But that's the sanctioned metaphor (NNOCCI educator).

In reference to a guide to climate change communication put out in partnership with EcoAmerica and Columbia University, the CUSP educator described how she applied the points she agreed with, while explaining further:

> I don’t know that I completely disagree with all of them, but the one that I always have a little bit of an issue with is the ‘speak from the mountaintops, don’t fight in the trenches.’ So, they’re talking about focus on the big picture, and I guess what they’re saying is arguing details is a problem. But sometimes in this local space the details are what people really care about, and so that’s the one that maybe doesn’t work as well for us (CUSP educator).

A CLEAN educator reflected on the difficulties of adapting his practice as he explained his climate change education work:

> And I'll also note that I’m speaking in a very deficit-model and I slip into that too often. Of course, deficits are real but a deficit approach is not generally the most effective way to communicate. I haven't fully come over to certain aspects of what I academically know. I don't viscerally know them, or something like that (CLEAN educator).

In summary, on a professional level, educators described changes in their practice related to framing addressing audience values and identity. On a personal level, some educators described feeling validated by research findings, yet some educators also experienced a tension between their research- and their practice-based knowledge.

Trends in Educator Framing

Exploring educators' framing of climate change offers another perspective on their incorporation of or alignment with climate change communication research implications.

Distance Frames

Guided by the emphasis in climate change communication research on psychological distance and distance frames, I asked educators whether they used global or local frames. Fifteen educators reported using local frames, 3 reported using a mix of distant and local, and only 1 educator reported using distance frames only (Table 7).

Table 7

Examples of local, combination local/global, and global frames

Distance Frames	**Examples**
Local/Close	Then we turn around and address it in ways that they've actually seen, you know increased insects, the increased wildfire, and how they're managing forests. Then they kind of understand because it's framed in a way that relates directly to them (PLT educator).
Local & Global Combination	There's been a real movement which I agree with that we have to make this relevant and local so people can say, 'Oh, in my backyard climate change is happening and it's real.' When we make it too local and don't connect back to the global piece, I think we do the rest of the world a disservice (CLEAN educator).
Global	I look at it, and therefore tend to discuss it, in terms of a global problem (PLT educator).

Those who emphasized local frames did so as a means of connecting with their audience's previous experiences. A PLT educator who worked with foresters explained why she liked using the PLT activity called "Changing Forests":

> We do the 'Changing Forests' one a lot because again that is talking about things that we have actually witnessed and things that we've seen (PLT educator).

A CLEAN educator described the overall approach of education at the museum:

> A place-based approach starting with local examples is more likely to be effective than not, than doing something different that's looking at you know polar bears or penguins or whatever (CLEAN educator).

A museum exhibit she designed reflects this approach by showcasing climate change impacts on the state's key agricultural products.

One PLT educator explained that she employed a global frame to prevent her audience from feeling too threatened:

> …because I think it at the same time makes people understand the scale of it but is less immediately personally threatening, if we're talking about the earth in general rather than your city is going to be underwater in 75 years. That's very threatening. (PLT educator).

Similarly, a CLEAN educator used global frames, admitting that, while she knew the current trend and recommended practice was to highlight local impacts, she resisted focusing solely on the local because she thought it meant "disconnecting ourselves from the rest of the world" and that "we do the rest of the world a disservice" when we focus on climate change at the local level.

Local frames present a challenge to some NNOCCI zoo and aquarium educators who work with exotic species. One NNOCCI educator explained that, for local school programs, she discusses local impacts, but a new climate-related exhibit highlights Australia and the South Pacific:

> Part of that was that some of our zoo guests are local and some of them aren't, so we didn't want to be bringing everything back to our state when that may not really hit half of our guests locally. And then we also wanted to create a sense of place throughout this loop, so we kept everything pretty focused to this area (NNOCCI educator).

Framing for identity and values

Educators reported employing a mix of identity-driven frames (Table 8). For one CCCF educator, tying climate change into natural impacts aided her in keying into her audience's identity as bird lovers:

> We need to connect that activity to this is really good for birds and beneficial to you know maybe absorbing more carbon you know for like planting something along those line (CCCF educator).

One CLEAN educator mentioned connecting to his audience's social identity group ("I'm talking to a Rotary Club, I'll start with the economy") while another emphasized the importance of appealing to her audience's "worldview, their tribe."

Table 8

Examples of identity-driven frames reported by educators

Identity-driven frames	**Examples**
Science as neutral	[This video] explains very well the science of climate change without talking politics at all. It's totally science-based (PLT educator).
Connecting to Religion	And as far as religion goes, doesn't the Bible say to take care of the forest? Isn't that, taking care of the forest, isn't that to follow God's directive? (PLT educator).
Emphasizing economy to municipal and business leaders	If I'm talking to a Rotary Club, I'll start with the economy (CLEAN educator).
	When you know your audience, you tailor it for them, and it has to have some economic spin to it. Towns are always concerned about money, so you want to present solutions that will help with the issue but also have these other co-benefits, like cost-effectiveness…water quality and community character and quality of life and all of that kind of stuff (NNOCCI educator).

For PLT educators, science frames functioned as a means of maintaining political neutrality. While their emphasis on using facts to achieve this seems at face value to contradict research on identity and motivated reasoning, it follows directly from the research used to evaluate the context in which southeastern teachers would be willing to teach climate change. When asked about their goals for workshops, PLT educators repeatedly described highlighting the science of climate change as a means of allaying skepticism and steering around political controversy, increasing certainty around climate change, and teaching critical thinking skills. One PLT educator discussed how skepticism in the United States about climate change affects her program goals:

> I think there's still a lot of skepticism in the United States that climate change is even happening, and so really we just want people to leave knowing that this is a real thing, and if we can show them some very good scientific evidence, I think a lot of times our participants sit there and go, 'Wow, I had no idea' (PLT educator).

This educator first identifies an audience identity: skeptic. Based on this, she describes shaping her goal for the program as one of the first steps to climate literacy—accepting climate change is happening—by using scientific evidence or information. Motivated reasoning research suggests that simply providing information will not sway skeptics; however, this educator perceived her programs as successfully shifting the knowledge base of skeptics.

Another PLT educator lived in a state in which less than half of the population believed that most scientists think climate change is happening and was somewhat skeptical himself as evidenced by him claiming: "climate change, the largest thing has been greatly oversold by a bunch of has-been washed-up actors and politicians." Yet he also sought to depoliticize the issue by grounding it in science:

I want them to be realistic. I want them to get over a lot of the hype, both left-wing and

> right-wing, and look at this as a scientific phenomenon…I want them to be critical thinkers, not just to accept everything they hear, but to be critical about it (PLT educator).

In discussing how she works with classroom educators, another PLT educator explained that she reminds them that environmental education is:

> …education and not advocacy. You know saying that really in that aspect you really have to be well-versed on both sides of the issue. So, that you can have discussions with people and just also reminding them that that's the goal of that module is to, you know, to teach about climate change, really to teach about adaptation for a changing climate (PLT educator).

This statement places the goal of the module itself outside of the realm of politics by describing the goal as "education" and *not* "advocacy" that could be tied to political ideology. That most PLT educators worked within or closely with southeastern state agencies may have been an incentive to remain neutral. As one educator explained:

> I've heard from some people some state agency folks aren't allowed to attend stuff like that because it is controversial, and either their director or administration doesn't lean towards believing it, so they're not allowed to attend. And some other school districts as well, well we're just not going to teach it or address it because it is controversial (PLT educator).

A PLT educator who worked as a children's programmer at a library described her goals differently, explaining that she wanted to:

> …open a dialogue on what climate change actually is: what things affect it, and how the average person or a group of people may be able to affect change (PLT educator).

Additionally, rather than emphasize the facts and the evidence, she critiqued one of the module videos for being too statistically oriented:

> The videos that we watched were very fact-oriented, very statistically oriented in some cases. We talked about whether or not statistics actually are useful for the general layman or not because sometimes and I personally kind of feel this way, you can pretty much say anything you want with statistics (PLT educator).

PLT educators' goal of maintaining neutrality and one PLT educator's statement regarding her distrust of statistics point to a larger goal of establishing trust with audiences

(including those comprising educators themselves), a fundamental aspect of effective communication.

Framing for Hope

Consistent with research that suggests using positive frames promotes efficacy, educators reported employing solutions frames to maintain hope and to inspire action among their audiences. Notably, solutions frames were used by 15 of the 19 educators. A NNOCCI educator talked about how energized the teachers in her teacher workshops get when they realize climate change as a classroom topic is "a really cool teachable moment in terms of it being interdisciplinary and totally relevant and focused on solutions." A CLEAN educator described giving audiences examples of climate related action happening:

> …particularly in the state or in their neighborhood is very powerful, and that's the hope part. Once they can see that these things are happening, they can be done and they can participate. That's where it becomes hopeful (CLEAN educator).

Another CLEAN educator discussed how difficult it is for her to:

> …not come across as all gloom and doom and how to give [children] some sense of hope… I point out things that are going on right now that people are doing, so locally for instance in our county there are a lot of businesses and organizations which are working and actually have been very successful to promote renewable energy (CLEAN educator).

A PLT educator described how she needed to provide "good news" and she wants educators in her workshops to "realize that there are things you can do to address this." In her case, she introduces educators to PLT's Green Schools Initiative, a program that encourages schools to improve energy use, waste and recycling, water consumption, school site, and environmental quality.

Educators' frame use did not seem to vary in relation to whether they were aware of research or not. PLT educators, however, described employing evidence or fact-based frames, whereas NNOCCI, CLEAN, and CCCF educators reported using more values-based frames.

Use of Figurative Language

Not surprisingly, NNOCCI educators reported using the metaphors developed for NNOCCI by FrameWorks Institute, although they reported using some more than others. "Heat-trapping blanket" was the most popular, while "climate's heart" and "rampant vs. regular carbon" were the least often cited. Even non-NNOCCI educators reported using "heat-trapping blanket." A CCCF educator who partnered with a NNOCCI educator on climate change projects described it as "so easy to understand. I think it's brilliant. It's succinct, it's relatable to everybody." Another CCCF educator described hearing about the heat-trapping blanket from evangelical climate scientist Katharine Hayhoe: "She has a beautiful way of talking about the heat trapping blanket."

A CLEAN educator described using an analogy to talk about extreme events with youth:

> You can't attribute a particular home run they've hit with steroids. So, the same thing with extreme weather. Climate change is leading to more extreme weather events, but you can't say any particular storm is due to climate change, but you can say that overall climate change is sort of like the atmosphere on steroids (CLEAN educator).

The CUSP educator described green infrastructure using an analogy: "Green infrastructure acts like a sponge and soaks up water before it gets into the sewer system."

Summary of Findings

Overall, educators were aware of climate change communication and psychology research. Several educators reported instrumental research use and changed their practice as a result of learning about research. NNOCCI, CUSP, CLEAN, and CCCF educators tied their appeals to values, identity, local framing, and use of metaphors to research. While it is not surprising that NNOCCI educators used the metaphors advanced by the NNOCCI training, educators' pride in using "research-tested" metaphors suggests that clearly presenting the

research foundations of practices promoted in professional development workshops could aid in the application of that research. PLT educators emphasized the scientific research foundations of the module to their audiences and focused on scientific evidence as a politically neutral approach to discuss climate change with their audiences. Educators from each group described framing climate change around solutions and trying to give audiences hope.

Discussion

Three main trends emerged from exploring environmental educator awareness and use of climate change community research: 1) research impacts these educators' practices 2) educators experience tension related to applying practice-based knowledge over research knowledge; and 3) even those practices that at face-value seem misaligned with research find precedent in the climate change communication literature. This discussion fills gaps in the conceptual framework presented in the literature review and addresses both the end result of educator practice change and the processes by which this occurred.

Knowledge brokers, particularly professional development programs, translated research and made it accessible to educators. These results contrast with those from research in formal education, which suggests that formal teachers rely more on practice knowledge even after participating in professional development (Finnegan, Daly & Che's 2013; van Driel, Beijaard, & Verloop, 2001). In this study, however, interviewees occupied mid-to-high level positions in their organizations, a factor correlated with higher likelihood of applying research to practice after attending professional development trainings (Hutchins & Burke, 2007). The high level of research use could also arise from the fact that this sample comprised a self-selected group of educators who were motivated to seek research-based resources to inform their programs. Fear of having divisive climate conversations and the complexity of the issue itself may also drive those interested educators to seek additional resources.

Educators gravitated toward the research applications that were easiest to apply to their current program models (Schneider, 2015), such as local framing because that was a known entity. Environmental education has long had a "place-based' thrust, and personal relevance is a hallmark of environmental education and environmental interpretation best practice (Tilden,

2008). Climate change research that validates place-based practice corroborates pedagogical approaches educators already held. The fact that all NNOCCI educators and even some non-NNOCCI educators reported use of NNOCCI metaphors suggests these were easy to use, both in talking with peers and in their programs. This research was "acceptable" to educators because it conformed with their practice knowledge (Schneider, 2015). However, educators' tendency to view novel research findings as familiar may lead to misinterpretation of the research and act as a barrier to instrumental practice change (Spillane, Reiser, & Reimer, 2002)

Educators integrated their audience assessments with their choice of distance frames. In some instances, this process led educators to use global frames, although both EE practice (Ham, 2013) and climate change communication (Scannell & Gifford, 2013) highlight how psychologically close or local frames can make content relevant. Indeed, educators' use of mixed global and local frames reflects a tension in the framing research itself, which suggests that while local frames are more psychologically close and may increase the likelihood of policy support or action, global frames have been shown to increase study participants' level of concern about the issue (Spence and Pidgeon, 2010). Additionally, local frames combined with sensational frames may lead to negative feelings towards climate change action (Otieno et al., 2014), which a PLT educator sought to avoid by using global frames.

Although the PLT educators' emphasis on facts set them apart from their colleagues in other programs, their effort to depoliticize climate change finds precedent in the communication literature and in the research in which the PLT module was based. When researchers address the idea of motivated reasoning in relation to climate change, they do so to illustrate that, as two of the educators noted, the facts are not enough to sway an audience to accept anthropogenic climate change because cultural cognition and emotion are more salient to their decision than is

logic (Kahan, 2015; Stevenson et al., 2015). PLT educators, however, talked about their fact-based approach in relation to their perception of their audience's political identities. In one cultural cognition paper, Kahan (2015) suggests depoliticizing climate change to depolarize it; for PLT educators, treating the issue through scientific evidence depoliticized it and enabled them to address audiences from a neutral, non-threatening stand-point. It should be noted that these educators live in southeastern states that, according to climate change attitude studies, have lower rates of climate change acceptance than other parts of the country (Howe, Mildenburger, Marlon, & Leiserowitz, 2015).

Some educators reported feeling validated by research findings, while others demonstrated a tension between conceptual and instrumental use of research as well as between their practice knowledge or personal opinions and the research. For example, while some NNOCCI educators felt comfortable developing their own metaphors and expressed their displeasure with the research-tested metaphors, many remained true to the "sanctioned" NNOCCI metaphors. Both NNOCCI and CCCF educators described changing their practice to highlight values, which reflects research on the role values play in climate change policy preferences (Leiserowitz, 2006) and intentions to behave (Krantz & Monroe, 2016). While the NNOCCI educators in this study discussed using Frameworks Institute tested values to frame their programs, a blog post on NNOCCI's *Climate Interpreter* website that attempts to dissuade educators from using "rogue" values implies other trainees have appealed to non-research tested values.

Limitations

One limitation of this research is that it describes how educators *report* discussing climate change rather than observing them in action to assess how they discuss climate change in active

practice. While this study maximized difference among participants by interviewing educators from multiple programs and states who worked with a wide range of audience types most educators were leaders in their organizations, and their perspectives may not match those of the people in their organizations or programs who do more direct delivery of program content. Additionally, the sample design and scope of research limited the sample to a group of mostly white women. This sample may typify what are traditionally considered environmental organizations, in which white women occupy mid-level management positions (Taylor, 2014), but it does not represent the breadth or diversity of educators in organizations that may deal with climate change education but not do not define themselves as environmental organizations (e.g., youth development organizations). Research suggests minorities in the US are significantly less polarized around climate change than are White people (Pearson & Schuldt, 2015; Schuldt & Pearson, 2016). Future research might broaden the scope of organization types considered to ensure a more diverse sample, which would elucidate communication trends across a wider range of climate change professionals.

Conclusion

As suggested by Nisbet & colleagues (2013), the application of communication techniques is messier than it appears in controlled framing study environments. Additionally, bridging the gap between research and practice represents a challenge that multiple academic fields continue to grapple with. Recent work demonstrates that NNOCCI educators do in fact apply the research-based tools they learned through the NNOCCI training (Geiger et al., 2017), but the present study provides a more granular view of how these educators consider their practice and which pieces of those research-based tools are most salient to their practice. The interviews demonstrate the tensions educators encounter as they teach climate change content to their audiences. Additional research should be devoted to understanding how education leaders like those interviewed for this study transfer their knowledge to their staff, on an organization-wide level, and into tangible education materials. The process of practice validation through research raises questions about the role of research in environmental education practice, as it may limit educators' application of research findings that challenge their current practice models.

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APPENDIX

Semi-Structured Interview Guide

Interview Questions and Prompts

- Tell me about your center.
    - Where is it located?
    - How would you describe your region?
    - What is the local community like?
    - What do you think your local community knows about climate change?
    - Who is the main audience at your center?
- What is your role in this organization?
- What kinds of climate change resources for planning programs would be helpful for you?
- Tell me about how you came to teach climate change.
- Describe a climate change program from your center.
    - How is the program structured? (e.g., is it a half-day program? A whole-day program? Do people come to you, or do you go to schools or other community locations?)
    - How would you describe your typical audience for this program? What kinds of activities do you run within the program?
    - What do you want participants to know, think, or do after they leave your program?
- Could you give me an example of how you describe climate change to your participants?
    - How do you frame climate change?
    - What kind of language do you use to talk about climate change?
    - Do you talk about climate change as a local problem? As a global problem?
- How would you describe your approach to teaching climate change? Do you use any particular teaching strategies?
- What information did you use to create your climate change programs?
- How would you rate the success of your climate change programs?
    - What is working well?
    - What isn't working well?
    - What would you like to change?
- Have you read any research about climate change communication? If so, what?
- Have you read any research about climate change education? If so, what?
- What kinds of climate change resources for planning programs do you have at your center?
- What kind of change have you seen in your organization's approach to climate change education over the last 5 years?
- Would you be willing to send a copy of your climate change lesson plans or other educational materials that you use? If you have run climate change related professional development workshops, would you be willing to send your advertising materials and a workshop agenda?